

REMARKS

Applicants submit herewith a declaration under 37 CFR 1.132 of Dr. Callander presenting evidence of the patentability of the claimed subject matter over the reference cited in the outstanding rejections and clearly explaining the difference between the claimed subject matter and the reasons why one skilled in the art would not combine the references as set forth in the Official Action.

Applicants have amended the claims to more particularly define the invention taking into consideration the outstanding rejections and to further emphasize specific aspects of the claimed invention as fully supported by the specification as originally filed and as it would be interpreted by one of ordinary skill in the art to which the invention pertains. In this regard, the Examiner's attention is particularly directed to pages 9 to 12 of the specification. Claim 112 has been added as a dependent claim which is dependent upon claim 111 and provides that the granules form a bed of granules with a maximum height of 4 to 5 meters as stated at the bottom of page 9 of the specification. It cannot be over-emphasized that the presently claimed invention is a commercially viable process with increased yield enabled by the specific processing steps of the presently claimed invention. Also it may reduce cost by requiring less crystallization as claimed in claim 117 as supported by the specification, page 13. The resulting polyester is particularly useful to form beverage bottles as further claimed in claim 118.

As noted at the bottom of page 9 of Applicant's specification, owing to the configuration of the reactors and in particular, owing to their inclination by an angle in the range 0.1° and 12° , preferably between 1° and 6° with respect to the horizontal line, the maximum polyester granules bed height is 4-5 meters. This in turn means very low compaction pressure if compared to conventional reactors, achieving thus the most important condition required to obtain high molecular weight PET or to obtain high output in terms of metric tons per day in a single line solid phase polymerization plant.

As stated on page 10, advantageously, the combination of the inclination and the rotation, preferably with a speed between of 0.1 and 10 rpm of the reactor ensures proper flow from one end to the other of the reactor and provides the constant renewal

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of the inter-granular contact areas so that the polyester granules do not have a chance to creep into one another.

As noted on page 10, the flow regime of the particles of the present invention is named "rolling" and this forms the subject of a further dependent claim, 113. This is important to the high output in terms of metric tons (see claim 116) in accordance with the commercial process of the presently claimed invention. This process is actually being performed and used to produce polyester granules which have obtained significant commercial success for the preparation of beverage bottles as a result of the processing steps and conditions as presently claimed.

In a further specific aspect of the invention as described on pages 10 and 11, it is noted that the polymerization is conducted in a stream of inert purge gas. A purge gas flow rate which is well below turbulent flow is generally preferred so as to prevent fluidisation and entrainment of polyester granules. Furthermore, when more reactors are present in series the inert gas flow rate will normally be approximately equal. In the latter case, it is preferred that the rate in each reactor not exceed 1.25 times the rate in any other reactor in a reactor series. This fully supports claim 114.

The Examiner's attention is also most respectfully directed to the second full paragraph on page 13 of Applicant's specification which points out that the process according to the invention provides greatly increased residence time, without increasing polyester granules bed height, thereby enabling higher increase in the polymer molecular weight and a higher size output in terms of metric tons per day in a single line solid phase polymerization, with respect to today's conventional available plants. Moreover, the process according to the invention allows the use of progressively higher temperatures in subsequent reactors, which therefore increases the overall polymerization rate with a parallel increase in process efficiency. These results are achieved by the processing steps as specifically defined in the presently claimed invention and not suggested by the prior art. Clearly, there is no expectation of increasing metric ton output in accordance with the process of the presently claimed invention, in the prior art. Applicants most respectfully submit that all of the claims now present in the application are in fully compliance with 35 U.S.C. 112 and are clearly patentable over the references of record.

Applicants note that the prior rejections of the claims as obvious over Coover in view of Kerpes have been withdrawn based upon Applicant's previously submitted amendments to the claims and comments. The comments in the previously submitted amendment with respect to these references are equally pertinent to the same references applied in the outstanding rejection and are herein incorporated by reference.

The rejection of claims 56, 59-63, 84-92, 95, 100-107, 109-111 under 35 U.S.C. 103(a) as being unpatentable over Kerpes in combination with Coover and as evidenced by Jones has been carefully considered but is most respectfully traversed. This rejection simply applies the references cited in previously withdrawn rejection, but in reverse order. Nevertheless, there is nothing in the prior art references applied in the rejections, in any combination, which suggest the presently claimed invention which results in an increase in production of metric tons over the prior art, and at reduced cost. The combination of references does not render the claimed subject matter obvious.

Kerpes' invention relates to a continuous process for the production of polyester for food packaging, by means of an optimized melt polycondensation and pelletizing, as well as a multi-stage heat treatment of the pellets. Kerpes is concerned about the free acetaldehyde content of PET which needs to be less than 0.5 ppm, and a bound acetaldehyde content of less than 5 ppm, in which these quality values are reproducible in every case, see column 5. The first aspect of the process is the melt polycondensation reaction so that the polycondensate (polyester, PET) has, at the reactor outlet, an intrinsic viscosity of 0.60 to 0.95 dl/g. The residence time and temperature of the polycondensation reaction is such to produce a product at the discharge outlet of the pelletizer which has less than 30 ppm, and preferably less than 25 ppm, higher acetaldehyde than it had at the discharge outlet of the reactor.

As declared in Dr. Callander's declaration, paragraph 10., Kerpes teaches that the molecular weight (I.V.) increase, also known as lift, be limited to only the amount needed to remove the acetaldehyde. (Col 3, lines 49-55). To accomplish this, Kerpes unequivocally teaches one of ordinary skill that the I. V. of the melt polymerized material be only slightly lower than the desired final I.V., for example 0.05 to 0.15 dl/g. (See again, Col 3, lines 49-55). Because one of ordinary skill knows that polyester food

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packaging requires a molecular weight (I.V.) of between about 0.65 dl/g and 1.00 dl/g, the melt I.V. cannot be below about 0.50. A minimum melt I.V. of 0.50 dl/g is outside and mutually exclusive with the preferred maximum of 0.45 dl/g I.V. of Coover (Col. 4, Lines 12-17). Moreover, Kerples teaches at column 3, line 35 an intrinsic viscosity range of 0.60-0.95 dl/g for the polycondensate at the reactor outlet and prior to the pelletizer. Again, one of ordinary skill in the art would understand this teaching is contrary to the teaching of Coover and leads one away from using the polycondensate of Kerples in Coover. There is no rational explanation of why one of ordinary skill in the art would combine the references in view of the clear teaching away from such a combination. Even under KSR, Applicants teaching may not be used to combine the references.

As noted at column 2, line 36 of the Kerples patent, the polyester pellets, having a specific surface area of 1.8 to 2.9 m²/kg are hardened at a temperature in the range between 30° and the first softening temperature, T_{e-1}(60-75°C) in air. The hardened polyester pellets are crystallized at a temperature and for a time sufficient for the first softening temperature to increase by 100° to 150°C, which value lying in the same range as the temperature at which the subsequent dealdehydization is carried out. During dealdehydization, at a temperature in the range of 175° to 225°C, the mass ratio of gas to polyester lies in a range from 0.05-10.0 to 1.0.

It is stated on page 4 of the rejection that Kerples does not teach reactor design. However, Kerples does teach reactor design at column 3 for the melt polycondensation reactor in which the reactor has multiple annular disks. In addition, it is noted at line 60 of column 3 that the pelletizer is, in accordance with the invention, directly connected to the outlet of the polycondensation reactor. At column 4, lines 46-47, of Kerples, it is stated that the hardened pellets are subsequently subjected, in the conventional manner, to crystallization which is then followed by dealdehydization in a solid bed. A fair interpretation of Kerples, by one of ordinary skill in the art, is that the standard PET process is utilized with the exception of the specific requirements specified in Kerples.

Applicants wish to note US Patent 6,403,762 which was issued on June 11, 2002 which is just prior to the priority date for the present application. The inventor on the '762 patent, Ben Duh, is the same inventor as on the '701 Duh reference applied in an

outstanding rejection in the present application. This is evidence of the '662 patents relevancy to the issues in the present application. Figure 1 of this patent is specifically noted as representative of the apparatus used for a conventional solid state polymerization process for PET at column 5, lines 38-45 of this patent. As noted therein, the dried and annealed pellets are then preheated to the reaction temperature in the preheater 4 before being charged into the reactor 5. This is obviously a vertical reactor which one of ordinary skill in the art would clearly understand to be the type of reactor used in the Kerpas "conventional" process and which is also discussed in the background of the invention for the present application. Therefore, Kerpas does describe reactor design which is to use to a conventional reactor system which would be understood by one of ordinary skill in the art to be the vertical reactors as discussed in the background of the present invention and not a horizontal reactor.

The statement at the bottom of page 4 of the Official Action that, "Use of horizontal, cylindrical, rotary reactor, which is being slightly inclined is beneficial, since it creates an reaction environment, allowing more effective removal of water and aldehydes" has been carefully considered but is most respectfully traversed. There is no indication in the Official Action of the basis for this statement. There is no disclosure of this in the Kerpas reference which directs one skill in the art to vertical reactors. There also is no disclosure of this in the Coover reference which is the secondary reference relied upon in the rejection. This statement is controverted by Dr. Callander, see paragraph 13 of his declaration.

Coover, as discussed in detail previously, relates to an entirely different process to provide small powder particles contrary to the granules used in the present invention. It does not establish an equivalence for solid phase polymerization processes using powders and those using granules as in the present invention. As stated at column 4, lines 18-22 of this patent, the powder buildup operation is conducted in an enclosed polymerizing zone wherein at least 5% of the volume is occupied by the particles (which are not granules). Such a zone can be a horizontal tube, upright cylinder or any other chamber through which inert gas can be conveniently moved across the surface of the particles. This does not support the allegation, at the top of page 5 of the Official Action,

that it would be obvious to a person of ordinary skill in the art to use a horizontal, cylindrical, rotary reactor in the Kerpes process, on the basis that this reactor design allows better removal of water vapors and aldehydes which is an unsubstantiated allegation. Again, there is no support for this statement nor has the Examiner pointed to any reasons to substantiate this allegation. It is most respectfully submitted that this statement simply represents the use of hindsight based upon Applicant's disclosure and even under KSR, such hindsight reconstruction is impermissible.

Moreover, there are the well known differences in powder and pellet processes as noted in the prior art and discussed in the Rinehart declaration of record. Mr. Rinehart explains in his Declaration that powders are normally processed in horizontal reactors, but that when using pellets it is preferred to not use horizontal rotating reactors due to the creation of undesirable fines when feeding pellets to a horizontal rotating reactor (see Declaration, paragraphs 12 and 13). This is evidence of record which contradicts the Examiner's position that one of ordinary skill in the art would use a horizontal rotating reactor for powders in a process design for granules.

These difference are further emphasized in the Callander declaration submitted herewith. As discussed therein, Coover on the other hand is diametrically opposed to Kerpes' requirement of a low I.V. lift. Rather than the IV lift being less than 0.15 dl/g, Coover teaches that the I.V. lift be at least 0.3 units and usually 0.4 units or more. (Col 2, Lines 37-39). Processing granules under these conditions would lead to the unmelts previously noted in the Callander declaration and as explained in the Callander declaration would render the granules of Kerpes unsuitable for use in the bottle of Kerpes, as taught by Kerpes (Col 1, lines 32-34).

Coover et al avoids the high I.V. skin and unmelts noted in the Callander declaration by using a very fine ground powder which overcomes the diffusion effects. Moreover, Dr. Callander agrees with Mr. Rinehart's declaration and his patent teaching that powders are not suitable for making bottles. The Callander declaration also notes that Kerpes et al requires a very specific granule size (Col 4, Lines 9-13), also discussed in the Examiner Interview, which is much larger than the powder of Coover and therefore does not permit grinding. Therefore, in order to meet the granule size required of

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Kerpes, one of ordinary skill is left with adding the granules of Kerpes et al to the rotating reactor of Coover et al and incurring its disadvantages noted below.

As stated in item 11 of the Callander declaration, The use of the granules of Kerpes in the rotating reactor of Coover et al would destroy the utility of the granules in Kerpes for bottles due to the discoloration of the resin. The polyester resin industry has for years measured color on its resin with discoloration being considered an almost absolute disqualification for use in bottles. While some polyester bottles are intentionally colored (green for 7UP, Amber for Beer), the vast majority of polyester bottles used for soft drinks are colorless/clear and as noted by Kerpes, the non-colored packaging should be highly transparent and subjectively colorless (Col 1, Line 34). Coover et al teaches that particles larger than a 20 mesh screen (840 micron or 0.840 mm) “tend to introduce discoloration and slow down the rate of molecular weight build up” (See Col 4, lines 71 – 73 and the previously defined particle size of less than 20 mesh (.841 mm at col 2, line 23). As also noted in the Callander declaration, the required particle size of granules in Kerpes et al is much larger than 20 mesh and the Kerpes granules would therefore process slower and would, in the end be discolored and make a bottle which is not subjectively colorless as required by Kerpes. Since making bottles is a primary purpose of Kerpes, it is inconceivable that one of ordinary skill would take the large granules of Kerpes et al and process them in a rotating reactor of Coover et al, when Coover et al says that the reaction rate will be slower and the resulting resin, and therefore bottle, will be discolored.

The size of the finely ground powder used in Coover is most evident from col. 2, lines 22-24 of the reference. This section states that the particles of prepolymer are capable of completely passing through a 20 mesh screen. One of ordinary skill in the art understands that a 20 mesh screen has openings of about 841 microns (0.841 mm). Accordingly, all particles in Coover must be smaller than 841 microns in order to pass through the openings in 20 mesh screen and the majority must be less than 30 mesh or 0.595 mm.

In this regard, Applicant wishes to point out that the particle size range taught for the Coover prepolymer particles would be understood by one of ordinary skill to be a

powder and not granules as required by the presently claimed process. See column 4, line 18 of Coover which refers to powder buildup and the Rinehart declaration of record, paragraph 6, which describe the polyester powders of Coover. See also USP 6,344,539 which at column 1 lines 18 -21 points out that it is known in the prior art that granules have at least one dimension greater than 1mm. Thus, one of ordinary skill in the art would clearly understand the meaning of granule as used in claim 56 and further amendment of this term is not necessary. Note also dependent claims 96-100 which specify particles size ranges consistent with the 1mm size for granules. The Rinehart declaration further notes that powders are not granules (pellets/chips).

The distinction between processes using granules and powders is well understood by one of ordinary skill in the art to which the invention pertains. As noted at column 1, line 57 through column 2, line 4 of the Rinehart USP 4,876,326 patent, "For example, it has generally been accepted practice to use polyester prepolymer in the form of pellets or chips in vacuum and static bed processes and finely ground powder in fluidized bed processes. The reason for this is that experience has shown that finely ground powders tend to agglomerate in vacuum processes, resulting in slower polymerization rates and a need to regrind the high molecular weight polyester resin produced. Experience has also shown that, in static bed processes finely ground powders will channel or fissure, resulting in uneven polymerization and prolonged polymerization rates. On the other hand, the use of pellets or chips in fluidized bed processes is not economically feasible in view of the velocity and volume of inert gas needed to suspend the pellets or chips and the size of the equipment required to do so. Thus, one of ordinary skill in the art of processing granules (Kerpes) would not look to the teachings of a powder process (Coover) to modify a process using granules in view of the established differences in the processes as recognized in the art.

This is especially true in view of Coover, which at column 4, lines 69-71, tacitly teaches one of ordinary skill in the art not to use granules but to stay within the limits set forth above, which at column 2, line 23 describes the 20 mesh requirement for the particle size. This is a teaching away from the use of granules as required by the presently claimed invention. Applicants also note MPEP §2143.01, which states in part

that, if a proposed modification would render the prior art invention unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

To the contrary, the granules recited in claim 56 are larger than 800 microns. As indicated in, e.g., claim 97, the granules have a diameter of 1 mm to 5 mm. As also indicated in, e.g., claims 96 and 100, the granules have a volume between 1 mm³ and 125 mm³. Accordingly, as evidenced by both the claims of the instant application and the general understanding of the term granule by one of ordinary skill in the art, based on the evidence of record including patents and the Rinehart declaration, Applicants respectfully submit that the granule recited in claim 56 is of a size generally larger than the finely ground particles disclosed in Coover.

That one of ordinary skill in the art of polyester resins knows that granules are larger than powders and that granules are different from powders is also established in the Rinehart patent referred to in the Rinehart declaration, of record. The Rinehart patent teaches that powders and granules are functionally different. Powders cannot be processed effectively using pellet/granule processing equipment due to channelling as would be appreciated by one of ordinary skill in the art. Accordingly, it is most respectfully requested that this aspect of the rejection be withdrawn.

It is urged on page 5 of the Official Action that regarding newly added claims 109-111 that these claims are related to process design which can be readily adjusted by one of ordinary skill in the art depending upon the features of the specific process. This argument requires first that one of ordinary skill in the art would substitute a horizontal reactor for the conventional vertical reactor for treating granules which has been demonstrate not to be the case. Moreover, even if this substitution were made there is nothing in the prior art to suggest the specific parameters in the claims would result in the unexpect increase in yield and quality of product and the commercial success achieved by the presently claimed invention. Further, it is most respectfully submitted that there is an infinite number of variables to be changed with respect to purge gas flow, temperatures of reactions, types of reactors and the like and clearly, the presently claimed invention, particularly in view of the commercial success and increase in

production, is not suggested nor rendered obvious by this combination of references. Accordingly, it is most respectfully requested that this rejection be withdrawn.

The rejection of claims 93-94 under 35 U.S.C. §103(a) as being unpatentable over Kerpes in combination with Coover and Tung et al. as evidenced by Jones has been carefully considered but is most respectfully traversed. The teachings of the Tung et al reference do not overcome the deficiencies of the Kerpes and Coover references as discussed above. Tung et al note that the low molecular weight polyester prepolymers utilized in solid state polymerization are generally in the form of pellets or chips at column 1, lines 23-26. The reference notes the sticking problem and the advantage of forming a crystalline chip but in not using a thermal heating process for this but instead in the presence of an organic vapor. This is further evidence for not using the heat crystallization process of the present invention and teaches away from the combination of Kerpes and Coover. Accordingly, it is most respectfully requested that this rejection be withdrawn.

The rejection of claims 93, 96-100 under 35 U.S.C. §103(a) as being unpatentable over Kerpes in combination with Coover and Duh et al. has been carefully considered but is most respectfully traversed. The teachings of Duh do not overcome the teachings of the primary references for the reason discussed above.

It is stated on page 7 of the Official Action that Coover and Kerpes do not teach the shapes of the particles. Kerpes' disclosure relates to pellets which are generally a spherical or cylindrical shaped body as defined by Webster's Collegiate Dictionary, Tenth Edition. Kerpes teaches a specific particle size. Coover is quite explicit that the "particles" are powders having specific size limitations, way below the size of the particles in Kerpes. The references are not combinable for this reason alone.

Applicant notes that Duh discloses using prepolymer granules in the shapes of pellets, spheres, chips or cubes for solid state polymerization, see column 1 line 20. It is noted in the reference that the prepolymers are generally converted from the amorphous to the crystalline state prior to solid state polymerization in order to raise their sticking temperature. This is done in order to keep the pellets or chips of polyester prepolymer from sticking together as a solid mass in the solid states polymerization

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reactor. However, Applicants note the comments above regarding the use of only finely ground particles or powder in the method and apparatus of Coover. Because Coover discloses a horizontally oriented rotating reactor, shear force will be exerted on any relatively large granules in the shape of pellets, chips, cubes or spheres placed therein and cause the creation of undesirable fines. In fact, any pellets, spheres, chips or cubes placed therein will be reduced to powders, thus making a step of creating pellets, spheres, chips or cubes worthless.

Furthermore, Coover expressly notes at col. 4, lines 69-73 that particles having a size larger than 20 mesh (i.e., 0.8 mm) are undesirable for use in the method and apparatus of Coover because they tend to introduce discoloration and slow down the rate of molecular weight buildup. Thus, Applicants respectfully submit that, with respect to modifying the invention of Coover to use larger particles based on the teachings of Duh, the Coover reference clearly teaches away from any such modification. One of ordinary skill in the art reading the Coover reference will readily understand that using larger particle sizes is undesirable. The particle size as taught by Coover, must be in the range specified in Coover, see column 4, lines 70 and 71, and column 2, lines 23 and 24. One of ordinary skill in the art would appreciate that this allows the process to be carried out in a horizontal reactor.

It is urged on page 8 of the Official Action that it would be obvious to a person of ordinary skill in the art that particle size and shape (i.e. surface areas at given mass) is the most important factor for diffusion of water from the particle. At high surface areas equilibrium of post polymerization reaction shifts to molecular weight increase, which makes a process more efficient. Therefore it would be evident to one skilled the art to use powder a powder particle as having the largest surface area and not the granules of the presently claimed invention since the process using granules would be less efficient in accordance with this analysis. Accordingly, it is most respectfully requested that this rejection be withdrawn.

The rejection of claim 95 under 35 U.S.C. §103(a) as being unpatentable over Kerpes in combination with Coover and Scannapieco has been carefully considered but

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is most respectfully traversed since the Scannapieco references does not overcome the deficiencies of the primary references for the reasons discussed above.

The Official Action urges that Scannapieco discloses using granules having carboxyl end group content that is less than 30% and that it would be obvious to use prepolymers with carboxyl acid group content below 30% in order to achieve high rate of the polymerization. However, this teaching does not overcome the deficiencies of the primary references as discussed above. Accordingly, it is most respectfully requested that this rejection be withdrawn.

In view of the above comments, further amendments to the claims and evidence submitted herewith, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,

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A04Final .wpd
May 18, 2009